Established in 2008

"बेटी बचाओ, बेटी पढ़ाओ"

Jayoti Vidyapeeth Women's University, Jaipur

NAAC Accredited | UGC Approved | Recognized by Statutory Councils

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING FRUIT PEELS AND THEIR APPLICATIONS IN DIFFERENT BIOLOGICAL FIELDS

Submitted by

BHUPENDRA TANWAR

Enrollment No :

JVR-I/22/10098

Under the Guidance of

DR. Y. CHANDRAKALA

Department of Science & Technology

Faculty of Education & Methodology

A Synopsis

Proposal Submitted in

fulfillment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

(BOTANY)

Estd. in 2008

''बेटी बचाओ-बेटी पढ़ाओ''

Jayoti Vidyapeeth Women's University, Jaipur

NAAC Accredited | UGC Approved | Recognized by Statutory Councils

GREEN SYNTHESIS OF ZINC OXIDE NANOPARTICLES USING FRUIT PEELS AND THEIR APPLICATIONS IN DIFFERENT BIOLOGICAL FIELDS

Submitted by

BHUPENDRA TANWAR

Enrollment No :

JVR-l/22/10098

Under the Guidance of

DR. Y. CHANDRAKALA

Department of Science & Technology

Faculty of Education & Methodology

A Synopsis

Proposal Submitted in

fulfillment of the requirements for the award of the Degree of

DOCTOR OF PHILOSOPHY

(BOTANY)

Jayoti Vidyapeeth Women's University
Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

Green synthesis of zinc oxide nanoparticles using fruit peels and their applications in different biological fields.

Introduction

Nanotechnology has been applied extensively in drug delivery to improve the therapeutic outcomes of various diseases. Tremendous efforts have been focused on the development of novel nanoparticles and delineation of the physicochemical properties of nanoparticles in relation to their biological fate and functions (Zhang *et al*., 2018).

Green nanotechnology incorporates the principles of green chemistry and green engineering to fabricate innocuous and eco-friendly nanoassemblies to combat the problems affecting the human health or environment. Subsequently, amalgamation of green nanotechnology with drug delivery area has actually commenced a new realm of "green nanomedicine" (Kanwar *et al*., 2019).

Synthesis of metal nanoparticles using plant extracts is one of the most simple, convenient, economical, and environmentally friendly methods that mitigate the involvement of toxic chemicals (Vanlaveni *et al*., 2021). Owing to their wide availability, renewability and environment-friendly nature, in addition to their vast applications in the synthesis of NPs, plant biomass are also largely targeted by our group and others as a catalyst for chemical synthesis (Rajkumari *et al*., 2019; Changmai *et al*., 2019) and biodiesel productions (Changmai *et al*., 2020; Bondarenko *et al*., 2013).

At the same time, there has also been significant interest shown toward developing sustainable eco-friendly practices and innovative strategies that can valorize plant-based food losses and wastes. Importantly, plant-based food waste is produced in extremely larger quantities and is also a renewable resource that is composed of many bioactive phytochemicals. The presence of large quantities of phytochemicals in plant-based food waste makes them attractive agents for the green synthesis of metal nanoparticles. This alternative green approach, besides being a potential waste valorization strategy, is also a method of reducing the dependence on hazardous chemicals and solvents commonly used in conventional manufacturing processes (Poinern and Fawcett, 2019).

Jayoti Vidyapeeth Women's University
Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

Cucurbits are important group of vegetables due to their nutritional signiûcance and their use in culinary and dessert purposes. But they produce large amount of waste both during consumption and processing owing to their thick rind and large seeds. These wastes generate potential problems for their treatment and disposal. They are of immense medicinal and food value and can be utilized in various fields (Shetty *et al*., 2012).

Objectives:

- Synthesis of zinc oxide nanoparticles using extracts of peels of cucurbits.
- Characterization of the synthesized nanoparticles.
- Evaluation of nanoparticles for their antioxidant, antidiabetic and anti-inflammatory activity in vitro.
- Evaluation of the nanoparticles for their antimicrobial activity.
- Evaluation of nanoparticles for their DNA cleavage activity of the selected microbes.
- Comparison of the above-mentioned activities of the synthesized nanoparticles with extracts of fruit peels as well as zinc solution.
- Statistical analysis of the data.

Research gap

Fruit peel waste of cucurbits is being utilized for various medicinal purpose. Silver and cerium oxide nanoparticles have been synthesized in few reports. But there is no previous study related to synthesis of zinc oxide nanoparticles using these fruit waste. Some studies have reported antimicrobial activity of zinc nanoparticles, but no study related to bacterial DNA cleavage is found yet. So, the proposed study will be done first ever for synthesis of zinc oxide nanoparticles using fruit peel extracts of cucurbits and their various applications in medicine.

Methodology

- Fruit peels of some cucurbits (pumpkins, watermelon, muskmelon, bitterguard etc.) will be collected and subjected for extraction in water.

Jayoti Vidyapeeth Women's University
Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

- These extracts will be used for synthesizing zinc oxide nanoparticles by the method of Rajive *et al*, (2013).
- Characterization will be done by UV, FTIR, FESEM, EDS, HRTEM, XRD etc to know the size, shape and purity of nanoparticles.
- Antioxidant activity will be determined using DPPH free radical assay (Valko *et al*., 2007) and FRAP assay (Wojtunik-Kulesza *et al*., 2020).
- Antidiabetic activity will be determined using glucose-DNSA assay (Miller, 1959).
- Anti-inflammatory activity will be determined using BSA method of Williams *et al*., (2002).
- Antimicrobial activity will be determined using well diffusion assay against some bacteria (Irobi *et al*., 1994) and fungi (Shafii *et al.*, 2005).
- DNA cleavage activity will be done for some bacteria and fungi by Agarose gel electrophoresis method (Jadhav *et al*., 2018).
- All test will be done in triplicates. Mean and standard deviation will be calculated. Using ANOVA, statistical variation in different doses of nanoparticles will be calculated using graph pad prism software.

Hypothesis

Collection of fruits peel and their extraction will be done using hygienic conditions. Zinc oxide nanoparticles will be synthesized using good quality practices. Characterization of the synthesized nanoparticles will be done in accredited laboratories. Biological activities will also be determined using standards and good quality chemicals.

Year wise work plan

First year

- Collection of fruit peels and their processing.
- Synthesis of zinc oxide nanoparticles.

Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

Second year work

- Characterization of nanoparticles.
- Antioxidant, anti-inflammatory and antidiabetic potential of nanoparticles.

Third year work plan

- Antimicrobial evaluation of the nanoparticles.
- DNA cleavage activity of the active nanoparticles.
- Statistical analysis of the data

Remaining tenure will be utilized in writing research papers and thesis.

Chaptarization of thesis

- Introduction
- Review of literature
- Materials and methods
- Observation and Results
- Discussion
- Conclusion and summary
- References

Instrumentations:

Weighing balance, incubating shaker, magnetic stirrer, centrifuge, UV spectrophotometer, FTIR spectroscopy, FESEM, bacteriological, laminar air flow, autoclave, vortex, sonicator, hot air oven, refrigerated centrifuge, agarose gel electrophoresis, PCR etc.

References

Zhang, R., Li, J., Zhang, T. *et al.* Importance of integrating nanotechnology with pharmacology and physiology for innovative drug delivery and therapy – an illustration with firsthand examples. *Acta Pharmacol Sin* **39**, 825–844 (2018). https://doi.org/10.1038/aps.2018.33.

Jayoti Vidyapeeth Women's University
Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

Kanwar R, Rathee J, Salunke DB, Mehta SK, 2019. Green nanotechnology-driven drug delivery assemblies. ACS Omega. 4(5): 8804-8815. https://doi.org/10.1021/acsomega.9b00304

Vanlaveni C, Lallianrawna S, Biswas A, Selvaraj M, Changmai B and Rokhum SL, 2021. Green synthesis of silver nanoparticles using plant extracts and their antimicrobial activities: a review of recent literature. RCS advances. 5.

K. Rajkumari , D. Das , G. Pathak and L. Rokhum , *New J. Chem.*, 2019, **43**, 2134 —2140 RSC .

B. Changmai , I. B. Laskar and L. Rokhum , *J. Taiwan Inst. Chem. Eng.*, 2019, **102** , 276 —282 CrossRef CAS .

B. Changmai , P. Sudarsanam and L. Rokhum , *Ind. Crops Prod.*, 2020, **145** , 111911

O. Bondarenko , K. Juganson , A. Ivask , K. Kasemets , M. Mortimer and A. Kahru , *Arch. Toxicol.*, 2013, **87** , 1181 —1200 CrossRef CAS .

Poinern GEJ and Fawcett D, 2019. Chapter 1- sustainable utilization of renewable plant based food wastes for the green synthesis of metal nanoparticles. Harnessing nanoscale surface interactions. Contemporary synthesis, applications and theory: Micro and nano technologies. 1-39. https://doi.org/10.1016/B978-0-12-813892-2.00001-X

Shetty A, Rana R and Buckseth T, 2012. Waste utilization in cucurbits: A review. Waste and biomass valorization. 3(3): 363-368. http://dx.doi.org/10.1007/s12649-012-9114-x

Rajiv, P., Rajeshwari, S. & Venckatesh, R. Bio-Fabrication of zinc oxide nanoparticles using leaf extract of Parthenium hysterophorus L. and its size-dependent antifungal activity against plant fungal pathogens. *Spectrochimica Acta Part A: Mol. Biomol. Spectr.* **112**, 384–387 (2013).

Wojtunik-Kulesza KA. Approach to Optimization of FRAP Methodology for Studies Based on Selected Monoterpenes. Molecules. 2020 Nov 12;25(22):5267. doi: 10.3390/molecules25225267. PMID: 33198134; PMCID: PMC7696166.

Milelr GL, 1959. Use of dinitrosalicylic acid reagent for determination of reducing sugar. Anal. Chem. 31(3): 426-428. https://doi.org/10.1021/ac60147a030

Jayoti Vidyapeeth Women's University
Estd. in 2008
''बेटी बचाओ-बेटी पढ़ाओ''

Irobi ON, Young MM, Anderson WA and Daramola. Antimicrobial activity of bark extracts of bridelia ferruginea (Euphorbiaceae). Journal of Ethnopharmacology. 43(2): 185-190.

Shafii Baftii, S., Shahidi Bonjar, G. H., Aghighi, S., Biglari, S., Rashid Farrokhi, P., & Aghelizade, A. (2005). Biological control of Fusarium oxysporum f. sp. melonis, the causal agent of root rot disease of greenhouse cucurbits in Kerman Province of Iran. *American Journal of Biochemistry and Biotechnology*, *1*(1), 22-26.

Jadhav, M. S., Kulkarni, S., Raikar, P., Barretto, D. A., Vootla, S. K., & Raikar, U. S. (2018). Green biosynthesis of CuO & Ag–CuO nanoparticles from Malus domestica leaf extract and evaluation of antibacterial, antioxidant and DNA cleavage activities. *New Journal of Chemistry*, *42*(1), 204-213.